Storage and Cooling Capacity in APPLE STORAGES in the Wenatchee-Okanogan, Washington, District

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PREFACE

This study brings up to date a 1941 survey of cold storages in the apple-producing districts of north central Washington. The objective is to provide the apple industry with data helpful in planning its storage and packing programs. With the information contained in this report and a good estimate of the expected crop, apple growers should be able to estimate whether or not they will need to seek storage space outside their respective districts considerably in advance of harvest.

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SUMMARY

A tabulation of apple storage cooling capacity and refrigerated storage space in the north central Washington district shows that, in the last 15 years, capacity and space have about doubled. In most shipping areas, production has not substantially changed. The increases in capacity and space have relieved nearly all the inadequacies that existed in 1941. In one district where production has increased, the storage cooling capacity and space, in spite of a threefold increase, is such that it is necessary for growers to seek cold storage space outside their area.

Although the installed storage capacity is approximately 21,000 carloads, use of a part of the space for pear storage and the greater space requirements for fruit held loose indicate that some common storage will be required when the apple crop reaches 18,000 carloads or more. In 1955, a fairly normal year, the crop was 15,600 carloads, but production varies widely from year to year.

STORAGE AND COOLING CAPACITY IN APPLE STORAGES IN THE WENATCHEE-OKANOGAN, WASHINGTON, DISTRICT

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INTRODUCTION

In 1941 a survey of the cold storage facilities in the apple-producing districts of north central Washington showed that the space available and the installed cooling capacity were inadequate for proper handling of the Delicious apple crop in the area.

Since that time, apple storage facilities have been continually expanded, and the deficiencies have been greatly reduced. As new plants have been constructed or existing plants expanded, data have been added to the report on the original survey, in order to make these data as up-to-date and complete as possible.

RESULTS OF SURVEY

The results of a survey as of the autumn of 1956, together with data from the 1941 survey, show the changes during this 15-year period and are presented in table 1. Apple production data compiled for the 1955 crop also are included. The 1955 crop figures were used rather than 1956 because the former more nearly represent a normal crop for the area.

Unfavorable weather over the past 6 years made it difficult to determine exactly what is a normal crop for the district as a whole, and even more difficult to set a normal production figure for each shipping area as set forth in the tabulation. The use of the 1955 crop as a normal production yardstick is considered the best guide available based on recent experience.

CALCULATION OF SPACE AND COOLING CAPACITIES

The procedure used in calculating space and cooling capacities is essentially the same as that used in 1941, with the exception of the procedure in determining how many loose boxes of fruit that can be cooled per day. Daily cooling capacity for each storage was estimated by dividing the net refrigeration capacity available for cooling fruit by the load imposed by cooling 1,000 boxes per day. The net refrigeration capacity is the total

Table 1.--Storage and cooling capacity of apple storages in the Wenatchee-Okanogan, Washington, district, 1941 and 1956

Producing and shipping area	Number of storages 1956	Storage capacity 1941	Storage capacity 1956	Daily cooling capacity 1941	Daily cooling capacity 1956	No. of days to cool Delicious production, 1955 crop	Total refrigeration capacity 1956	Estimated daily packing capacity, 1956	Apple production 1941	Apple production 1955	Pear production 1955	Estimated boxes to be stored at end of apple picking 1955
		Boxes	Boxes	Packed boxes	Packed boxes	Days	Tons	Boxes	Packed boxes	Packed boxes	Packed boxes	Boxes
Oroville, Ellisford, Tonasket...	18	605,000	2,377,440	22,000	75,950	1/ 25.4	854	42,800	1,326,000	2,410,000	9,000	2,655,000
Omak, Okanogan, Mallot....	12	669,000	1,486,780	28,800	59,370	1/ 17.0	590	23,500	1,440,000	1,274,000	11,000	1,403,000
Brewster, Pateros....	18	655,000	2,074,350	25,800	70,860	2/ 17.0	750	21,100	1,239,000	1,405,000	10,000	1,574,000
Chelan, Azwell, Manson.....	22	1,280,000	2,393,490	43,500	80,860	2/ 21.0	925	34,600	2,099,000	2,085,000	14,000	2,316,000
Entiat.....	12	353,000	1,157.270	19,700	50,480	1/ 12.0	535	20,200	922,000	761,000	70,000	865,000
Wenatchee and vicinity, Orondo.	40	2,540,000	3,278,810	94,000	138,400	3/ 10.0	1,402	64,950	2,186,000	2,000,000	402,000	2,294,000
Monitor, Cashmere, Dryden.....	18	1,130,000	2,549,780	47,800	85,690	1/ 17.0	984	44,600	2,059,000	1,840,000	493,000	2,265,000
Leavenworth, Peshastin..	5	650,000	1,405,660	17,000	47,340	1/ 11.5	494	21,000	661,000	690,000	147,000	800,000
Total north central Washington.	145	7,882,000	16,723,680	298,600	606,950	13.5	6,534	272,750	11,942,000	12,465,000	1,156,000	14,172,000

1/ Based on Delicious representing 80% of production.
2/ Based on Delicious representing 85% of production.
3/ Based on Delicious representing 55% of production.

refrigeration capacity minus the fixed loads calculated for heat transmission into the storage and heat generated by fans and pumps operating in the storage. Total refrigeration capacity has been calculated from the displacement of compressors installed and the operating pressures prevalent during the receiving season.

The load for cooling packed boxes has been estimated at 8 tons of refrigeration per 1,000 boxes entering the storage per day. This figure allows approximately 25 percent for air infiltration and heat from lights, men, and equipment, which are assumed to be proportional to the receiving activity. This figure is based on fruit being cooled from 65° F. to 32° F. and includes the respiratory heat given off by the fruit if 6 days were required for cooling through this range. These same assumptions were used in calculating the total cooling capacity of the district in 1941.

In 1941, it was assumed that when fruit was cooled before packing, it would be cooled for only a few days and then withdrawn from storage, packed, and placed back in storage during the normal receiving season. This meant that cooling before packing would involve some penalty for cooling culls and for the warming of fruit that takes place during packing. In the 1941 survey, when fruit was cooled before packing, the load was estimated at 10 tons of refrigeration per 1,000 packed boxes.

The current situation with respect to loose fruit is quite different. The percentage of culls is normally very low. Most loose fruit that goes into storage is not withdrawn for packing until after the receiving season, since plenty of space is available for holding it loose, and, from a handling standpoint, it is most efficient to pack as much fruit as possible directly from the field. Neglecting culls and figuring only the cooling required for loose fruit, the load per 1,000 loose boxes received is 5.3 tons of refrigeration.

Part of the cooling capacity is devoted to cooling fruit that has been packed as it comes from the field, and some uncertainty exists regarding the effect of culls on the ultimate capacity. Also, the production figures for the various shipping areas are available in terms of packed boxes. This analysis therefore is simplified by judging cooling capacity on the basis of the capacity to cool packed fruit. With no cullage, this assumption actually requires 16 percent more cooling capacity than would be the case if all fruit were cooled loose and packed after the receiving season. This is based on the assumption that 1,300 loose boxes pack out to 1,000 packed boxes and the cooling load is 5.3 tons and 8.0 tons per 1,000 boxes, respectively. Therefore, the refrigeration required is 1.1 tons greater for the 1,000 packed boxes than for the 1,300 loose boxes. Inasmuch as the actual operation of the storages is that of receiving both packed and loose fruit, the allowance for variations in amounts involved in the analysis used is about 8 to 10 percent.

These data can throw some light on three important questions:

(1) Is the cooling capacity adequate to handle the Delicious apple crop?

(2) Is the space adequate for placing a normal crop in cold storage as fast as it can be hauled from the orchard?

(3) Are the facilities well distributed among the shipping and producing areas?

CAPACITY ADEQUATE FOR DELICIOUS APPLE CROP

The overall picture of cooling capacity for Delicious apple production is favorable. If it is assumed that no other commodities will be in the storages, capacity now exists to cool the entire Delicious crop in 13.5 days. In a report published by Hukill and Smith in 1942, it was suggested that the Delicious apple crop should be harvested in 15 days. 1/ If picking started at about the same time throughout a producing district and the fruit was promptly hauled to the warehouse and cooled, a capacity capable of cooling the Delicious apple crop in 15 days would be required. In certain of the shipping areas such as the Monitor, Cashmere, Dryden area, the Chelan, Azwell, Manson area, and the Brewster, Pateros, Methow Valley area, differences in elevation and climatic conditions within the area tend to spread out the picking season, giving some leeway in the 15-day figure.

CAPACITY IN INDIVIDUAL AREAS

Examination of the cooling capacity for all apples for individual areas shows that growers in the Oroville, Ellisford, Tonasket area might need to seek space outside the area to store some of their crop. This need exists in spite of a more than threefold increase in cooling capacity in the area during the period studied. Production in this area has almost doubled since 1941, whereas other areas have shown little increase and in some cases production has decreased. The figures indicated that growers in the Chelan, Azwell, Manson area also might need to seek space outside their area.

Adequacy of Available Space

The answer to the second question, regarding adequacy of available space, involves a number of assumptions. At the time when space is most needed, i.e., at the end of harvest, a number of things have been happening that affect the total amount of fruit to be stored.

1/ Hukill, W. V. and Smith, Edwin. Apple Storage in the Wenatchee-Okanogan Valley. USDA, Bur. Agr. Chem. and Eng., ACE 182 mimeo. 1942.

In the Wenatchee and Wenatchee Valley areas, the pear crop plays an important part in the space picture. Records indicate that at the end of apple harvest about 10 percent of the Bartlett pears for canning still remain in storage, awaiting shipment to the canneries. More than 75 percent of the pears, mainly Bartletts and D'Anjou, that have been packed for the fresh market, remain in storage. The number of boxes packed during the picking period is estimated to be equal to the amount of apples which would be packed during 20 days at full packing capacity.

By the end of the picking period in 1955, about 1,500 carloads of apples had been shipped to market, and the rest remained in storage. At this time, the unpacked part of the crop remained in storage in field boxes, occupying about 30 percent more space than would be required when the fruit is packed.

An estimate of the space situation based on these assumptions has been made with the 1955 crop for the various shipping areas and is given in table 1. This shows that all shipping areas except the Oroville, Ellisford, Tonasket area had adequate space for the 16,000-carload crop. By an extension of this analysis, it appears that for the district as a whole, the cold storage facilities would start to become crowded and some fruit would have to be held in common storage sheds or in refrigerated space outside the area when something over an 18,000-carload crop was produced.

The figures presented do not take into account the movement of fruit into cold storage facilities in the Entiat and Wenatchee areas from the Oroville and other up-river areas. Storage-in-transit freight rates are available that make such movement advantageous and, as a result, 682 carloads, or 544,000 boxes moved into the Wenatchee and Entiat areas in 1955. As a result, the space requirements of the Oroville, Ellisford, Tonasket areas were met. Cooling capacity requirements also were alleviated by this movement.

SPACE NOW AVAILABLE FOR ALL VARIETIES

There are apparent differences between operations now and at the time of the original survey in 1941. In 1941, the Delicious crop in packed boxes would have occupied 80 percent of the available space. The present Delicious crop would take more space than the total space then available. At that time, the chief concern was to take care of the Delicious crop. Now the cold storages are able to provide refrigerated space for all varieties. Because of the shortage of space in 1941 and the high cullage then encountered, the emphasis was on packing as fast as possible and placing a minimum of loose fruit in cold storage. Now, with more space available, with less severe cullage, and with marketing changes, a trend toward storing the fruit loose and packing it later over a somewhat more extended season is noted in a number of storages.

The data regarding space and cooling capacity available in the various areas have been presented on an overall average basis. Variation exists

between individual plants in the ratio between the box capacity of the storage and the number of boxes that can be cooled per day. Most of the larger plants serving more than one grower have storage capacity and cooling capacity ratios that permit filling their storages with packed fruit in about 25 days without exceeding the loads for which their refrigeration plants were designed. If such plants were to be filled with loose fruit, the filling could be accomplished in 17 days without overloading the refrigeration systems. Most of the individual-grower, ranch-type installations, have capacity-volume ratios that permit filling with loose fruit in 11 days without overload. However, a greater variation of adequacy was found in the small plants.